

REMARKS

This is intended as a full and complete response to the Office Action dated January 27, 2003, having a shortened statutory period for response set to expire on April 28, 2003. Please reconsider the claims pending in the application for reasons discussed below.

The drawings have been amended as to form to include the misplaced references, the omitted reference numbers and symbols, and to correct typographical errors. A drawing amendment is submitted herewith. It is believed that the amendment is supported by the specification and the drawings without adding new matter, and should be entered.

The specification has been amended to correct typographical errors. It is believed that the amendment is supported by the specification and the drawings without adding new matter, and should be entered.

In addition, Applicant has canceled claim 47 without prejudice. Applicant reserves the right to pursue the subject matters of canceled claim 47 at a later date. Cancellation of claim 47 is not a concession that the claim is not patentable, but rather reflects Applicant's decision to pursue the subject matter of claims 46 and 48-72.

Applicants have amended claims 46 to more clearly recite the claimed aspect of the invention and substantially include the limitations of canceled claim 47. It is believed that no new matter has been introduced.

Claims 46 and 48-72 stand rejected under 35 U.S.C. 103(a) as being obvious over Japanese Patent No. 10050802, in view of *Kuriki et al.* (U.S. Patent No. 6,264,748), *White et al.* (U.S. Patent No. 6,235,634), *Edwards et al.* (U.S. Patent No. 5,944,857), and *Tanaka et al.* (U.S. Patent No. 5,976,327). The Examiner states that Japanese Patent No. 10050802 discloses a processing system with a single load lock No. 52 for each processing chamber No. 56, but lacks a parallel system, a movable lid and lift pins. The Examiner also states that *Kuriki et al.* and *White et al.* disclose load locks in parallel system, and *Edwards et al.* discloses the use of a movable lid No. 52, while *Tanaka et al.* discloses the use of lift pins No. 38. The Examiner asserts it would

have been obvious to provide these features to the primary references to increase throughput.

Applicant respectfully traverses this rejection. Japanese Patent No. 10050802 discloses a processing system having sequential connection of a cassette loading chamber 10, a load lock chamber 52, a transportation chamber 54, and a processing chamber 56. Japanese Patent No. 10050802 further discloses a cassette transporting robot 20 within the cassette loading chamber 10, a wafer boat 70 within the load lock chamber 52, a wafer transporting robot 80 within the transportation chamber 54.

Japanese Patent No. 10050802 does not teach, show, or suggest a transfer robot disposed in the load lock chamber, as recited in claims 46 and 48-72. In addition, Japanese Patent No. 10050802 does not teach, show, or suggest a parallel system, as pointed out by the Examiner.

Kuriki et al. discloses a multichamber integrated process system having a cassette station 1, a transferring section 10, a processing section 2, and an interface section. The processing section 2 is divided into multiple process blocks 2a-2d connected by multiple transferring apparatuses 17-19 and 111. Process block 2c contains a lock chamber 51 connected to a transferring chamber 52 and two process chambers 53 and 54. Process block 2d contains a lock chamber 121 connected to a transferring chamber 122 and two film forming chambers 123 and 124. Each transferring chamber provides a substrate transferring member 70 (a robot) of a multi-joint arm type to receive and transfer substrates.

Kuriki et al. does not teach, show, or suggest a transfer robot disposed in the load lock chamber, as recited in claims 46 and 48-72. The substrate transferring member 70 of *Kuriki et al.* is disposed outside the load lock chamber. In addition, *Kuriki et al.* does not teach, show, or suggest each load lock chamber is connected to a single process chamber, as recited in claims 46 and 48-72.

White et al. discloses a processing system having four islands 42A-42D on opposite of a track 44 and a robot 70 movable along the track 44. Each island includes a load lock chamber 50 for heating, a load lock chamber 52 for cooling, and at least one processing chamber 54 (See, Col. 4, lines 47-54.) In addition, substrates are delivered to each heating load lock chamber and received from each cooling load lock chamber

via an atmospheric loading robot 128A and an atmospheric loading robot 128B, respectively. Both atmospheric loading robots, 128A and 128B are disposed outside of the respective load lock chambers.

White et al. does not teach, show, or suggest a transfer robot disposed in the load lock chamber, as recited in claims 46 and 48-72. In addition, *Kuriki et al.* does not teach, show, or suggest each load lock chamber is connected to a single process chamber, as recited in claims 46 and 48-72. The two load lock chambers of *White et al.* are connected to a single process chamber for delivering substrates into and outside of the process chamber, respectively.

Edwards et al. discloses a wafer manufacturing cluster tool 30 having process chambers 34a-34d, a transfer chamber 33, and a plurality of single wafer load locks 37a-37b, each for transferring a single wafer. The transfer chamber 33 has a pivotal and extendable wafer transfer arm 35 (robot) of a commercially available type. (See, Col. 7, lines 5-15.) *Edwards et al.* further discloses moving wafers inbound to the high vacuum atmosphere through one load lock and moved outbound through another load lock, the outbound load lock also actively cooling the wafer. Specifically, a wafer transfer device robot 42 is disclosed for transferring wafers into the inbound load lock and from the outbound load lock.

Edwards et al. does not teach, show, or suggest a transfer robot disposed in the load lock chamber, as recited in claims 46 and 48-72. The robots 35 and 42 of *Edwards et al.* are disposed outside the load lock chamber. In addition, *Edwards et al.* does not teach, show, or suggest each load lock chamber is connected to a single process chamber, as recited in claims 46 and 48-72.

Tanaka et al. discloses a method and an apparatus for depositing a metal film on a substrate including a high density plasma physical vapor deposition (HDP PVD) chamber and a controller to modulate a RF bias power applied to a substrate in the chamber.

Tanaka et al. does not teach, show, or suggest a load lock chamber, nor a transfer robot disposed in the load lock chamber, as recited in claims 46 and 48-72. In addition, *Tanaka et al.* does not teach, show, or suggest each load lock chamber is

connected to a single process chamber, as recited in claims 46 and 48-72. Applicant respectfully requests the Examiner to withdraw the rejection.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest aspects of the invention. The references neither alone nor in combination, teach, show or suggest a transfer robot disposed in each load lock chamber, as recited in claims 46 and 48-72. Further, the references neither alone nor in combination, teach, show or suggest a semiconductor processing system having a plurality of load lock chambers in which each load lock chamber is connected to a single process chamber, as recited in claims 46 and 48-72. Having addressed all issues set out in the office action, applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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Appendix

IN THE SPECIFICATION:

Please replace the paragraph at page 1, lines 13-23, with the following paragraph:

The use of cluster tools in semiconductor wafer processing is well known. Examples include the CENTURA[®] and ENDURA[®] platforms available from Applied Materials, Inc., located in Santa Clara, California. An example of a typical cluster tool 100 is shown in Figure 1. Cluster tools generally include mounting a plurality of process chambers 104 to a transfer chamber 102. The transfer chamber 102 houses a centrally located robot 120 which communicates with the process chambers 104 through slit valves (not shown). Current practice includes the use of load locks 108 as intermediary chambers between pod loaders 115-118, a plurality of mini-environments 114, and the transfer chamber 102. The load lock 108 is continuously alternated between ambient pressure when communicating with pod loaders 115-118 and a vacuumed condition when communicating with the transfer chamber 102.

Please replace the paragraph at page 9, lines 1-9, with the following paragraph:

A first end of the first strut 358 is pivotally connected to the blade 262 at a first wrist joint 370 [270], while a first end of the second strut 358' is pivotally connected to the blade 262 at a second wrist joint 370' [270']. The first and second wrist joints 370, 370' [270, 270'] define a leading axis C. Similarly, the first and second pivot joints 372, 372' define a lagging axis D. A ramped backstop 271 biases the blade 262 toward the aperture 248 such that axis C leads axis D by a short distance (a few millimeters). The backstop 271 ensures that axis C and axis D retain their relationship and that the blade 262 is always moved outward upon counterclockwise rotation of the first drive arm 354 and inward upon clockwise rotation of the first drive arm 354.

Please replace the paragraph at page 9, lines 10-17, with the following paragraph:

In the retracted position of the transfer robot 204, the first and second drive arms 354, 354' and first and second struts 358, 358' rest along the chamber wall 210 such that a central portion of the chamber cavity 201, having a diameter approximately equal to the wafer 250, is occupied only by the blade 262. In a fully extended position, a phantom transfer robot 204' shows the central portion of the chamber cavity 201 unoccupied. In this position, a wafer may be vertically transferred above and below the transfer plane within the central portion of the chamber cavity 201 by the lifting mechanism [transfer assembly] 232.

Please replace the paragraph at page 9, lines 28-30, and at page 10, lines 1-26, with the following paragraph:

Figures 4a-4d show a wafer transfer within the present invention. Initially, an atmospheric robot blade 285 positions a wafer 250 between the raised lid 216 and the cover 206, and over the blade 262 as shown in Figure 4a. In order to receive the wafer 250, the lifting mechanism 232 raises the pins 234 above the atmospheric robot blade 285 while the atmospheric robot blade 285 withdraws from above the chamber body 202 as shown in Figure 4b. Figure 4c shows the lifting mechanism 232 lowering [lowing] the pins 234 until the wafer 250 is deposited on the blade 262. The support pins 234 then continue to retract below the transfer plane B. Simultaneously, the lid 216 is lowered onto the cover 206 causing the first seating surface 214 and the second seating surface 218 to sealingly engage (shown in Figure 4c). The vacuum pump 251 (shown in Figure 2) then pumps the chamber cavity 201 down to a pressure substantially equal to the base pressure of the process chamber 249 (also shown in Figure 2). Once a transfer pressure is reached, the sealing door 256 is opened to provide fluid communication between the process chamber 249 and the load lock chamber 200. As shown in Figure 4d, the blade 262 is then extended into the process chamber 249 to deliver the wafer 250 above the wafer support member 247 (shown in Figure 2) where a

lift mechanism (not shown) can position the wafer 250 onto the wafer support member 247 for processing. After delivering the wafer 250 into the process chamber 249, the blade 262 is retracted and the sealing door 256 is closed. The process chamber 249 is then pumped down to its base pressure and the wafer 250 undergoes processing. Upon completion of the processing step, the steps described above are performed in reverse. Specifically, the sealing door 256 is opened and the blade 262 is extended into the process chamber 249 to retrieve the wafer 250. The blade 262, carrying the wafer 250, is retracted and the sealing door 256 is closed. The chamber cavity 201 is then pumped up to ambient pressure. The actuating mechanism 222 raises the lid 216 while the lifting mechanism 232 raises the pins 234 and, consequently, the wafer 250, above the transfer plane of the atmospheric robot blade 285. The atmospheric robot blade 285 is then extended beneath the wafer 250 and the lifting mechanism 232 lowers the pins 234 leaving the wafer 250 on the atmospheric robot blade 285.

Please replace the paragraph at page 11, lines 6-15, with the following paragraph:

Figures 5-9 show a second embodiment of the present invention adapted to handle two wafers. The second embodiment generally comprises a multi-wafer transfer assembly. The transfer assembly includes a first pair of cooperating lift forks 420 coupled to a first Z- θ actuating assembly 460 (shown in Figures 6 and 9) and second pair of cooperating lift forks 422 coupled to a second Z- θ actuating assembly 462 (shown in Figure 6). As shown in Figure 6 the Z- θ actuating assemblies 460, 462 are mounted to the lid 216 to impart vertical (Z) and rotational (θ) motion to the lift forks 420, 422 respectively. The Z- θ actuating assemblies 460, 462 are discussed in detail below. A wafer support [is] 424 is provided to support a wafer thereon below the transfer plane of internal robot 204.

Please replace the paragraph at page 14, lines 29-30, and page 15, lines 1-28, with the following paragraph:

Upon completion of processing, the process chamber 249 is pumped up to a transfer pressure, the sealing door 256 is opened, as shown in Figure 10j, and the blade 262 is extended into the process chamber 249 to retrieve the first wafer 500. The blade 262, carrying the first wafer 500, is then retracted, as shown in Figure 10k, and the first pair of forks 420 is actuated toward the wafer 500. Upon breaching the transfer plane B, the lift elements 432 are rotated and positioned under the wafer 500 and the lift forks 420 are raised to a position above the transfer plane B to support the substrate as shown in Figure 10l. Subsequently, the blade 262 is again extended into the process chamber 249. While the blade 262 is parked in the process chamber 249, the first pair of forks 420 are lowered below the transfer plane B to position the wafer 500 onto the wafer support member 424 as shown in Figure 10m. In Figure 10n the lift elements 432 are rotated and raised to a position above the transfer plane B and the blade 262 is again retracted. Simultaneously, as shown in Figure 10o, the second pair of forks 422 is actuated toward the transfer plane B to position the second wafer 502 onto the blade 262. Once the wafer 502 is positioned on the blade 262, the second pair of forks 422 is rotated and actuated to a position above the transfer plane B. The blade 262 is then extended into the process chamber 249 carrying the wafer 502 as shown in Figure 10p. Simultaneously, the first pair of forks 420 is lowered to retrieve the wafer 500 from the wafer support 424, also shown in Figure 10p. Once the wafer 500 is raised above the transfer plane B, the blade 262 is retracted. Upon retraction of the blade 262, the sealing door 256 is closed and the process chamber 249 is pumped down to its base pressure for processing wafer 502. Simultaneously, the load lock 200 is pumped up to ambient pressure. In order to exchange the wafer 500 for another wafer, the lid 216 and both pairs of forks 420, 422 are raised as shown in Figure 10q. Figure 10q [10r] and 10r show the atmospheric robot blade 285 extended below the first wafer 500 at which point the first pair of forks 420 lowers the wafer 500 onto the atmospheric robot blade 285. The first pair of forks 420 is then rotated. The atmospheric robot blade 285 is retracted to dispose of the wafer 500 in the wafer cassette (not shown) and again extended carrying an unprocessed wafer which is positioned on the second pair of forks 422. The forks 420, 422 and lid 216 are then lowered and the steps are repeated.

Please replace the paragraph at page 15, lines 29-30, and page 16, lines 1-15, with the following paragraph:

In another embodiment shown in Figure 11, the load lock 200 shown in Figure 2 is modified to include a solid cover 504 and a slit valve aperture 506 formed in the chamber wall 210 at the rear of the load lock 200 providing back-loading access for an atmospheric robot (not shown) to transfer wafers. A slit valve apparatus 510 located adjacent and behind the load lock 200 is selectively activated to seal the load lock chamber 200. The slit valve apparatus 510 generally comprises an elongated door 512 coupled to an actuator 514 to move the door 512. An o-ring 516 is disposed on a sealing surface of the door 512 to hermetically seal the load lock 200. The slit valve apparatus 510 may be any commercially available slit valve apparatus such as the one disclosed in U.S. Patent No. 5,226,623 assigned to Applied Material, Inc., of Santa Clara, California, which is incorporated by reference herein. Alternatively, any other sealing apparatus, such as a gate valve, may be used to advantage. In operation, the door 512 is opened and an external robot blade (not shown) delivers a wafer (not shown) into the chamber cavity 201. The lifting mechanism [lift pin assembly] 232 (shown with the lift pins 234 in a lowered position) is raised to receive the wafer. The lift pins 234 are then lowered to deposit the wafer onto the transfer robot 204 while the external robot blade is retracted and the door 512 is sealed.

Please replace the paragraph at page 16, lines 16-27, with the following paragraph:

In each embodiment disclosed above, a shield, or cover 264 (shown in Figure 2), may be employed to surround the load lock 200 and define a clean environment 267 about the load lock 200. The cover 264 provides protection from particles which might otherwise migrate into the chamber body 202 [200] and deposit themselves on a wafer. Such particles can lodge within interconnect features of semiconductor wafers resulting in defective devices. A filtration system 268 (shown schematically) operates to maintain the clean environment 267. A loading aperture 266, which is selectively opened and

closed by a sealing apparatus (not shown), provides access for an external robot blade (not shown). The external robot blade is preferably located in an adjacent clean room (multiple embodiments of which are described below with respect to Figures 12 and 13) adjacent and behind the load lock 200. Other embodiments designed to shield the load lock 200 from contamination are discussed below.

Please replace the paragraph at page 17, lines 26-30, and page 18, line 1, with the following paragraph:

Figure 13 shows another configuration incorporating the present invention wherein a system configuration 700 is linear and an atmospheric robot 702, traveling along a track 705 [704] requires two degrees of freedom, X- θ . The cassettes 606 are located on one side of the track 705 [704] while the load locks 200 and attached process chambers 604 are located on the other side. The atmospheric robot 702 travels along the track 705 [704] and communicates with the cassettes 606 and the load locks 200.

IN THE CLAIMS:

Please cancel claims 47 without prejudice.

Please amend claims 46 with the replacement claim presented below.

46. (Amended) A semiconductor processing system, comprising:
a mini-environment coupled to a wafer cassette;
a robot disposed within the mini-environment;
one or more load lock chambers connected to the mini-environment; and
one or more process chambers connected to the one or more load lock chambers, wherein each load lock chamber is connected to a single process chamber, wherein each load lock chamber comprises:

an enclosure having a bottom, a lid and sidewalls defining a chamber
cavity; and
a transfer robot disposed in each load lock chamber.